

## INVESTIGATION OF PONDEROSA PINE ROOTS

### I. Object

To determine the morphology of the roots of ponderosa pine and associated species.

### II. Purpose

The purpose of this study is to gain a knowledge of that portion of the tree "below the ground" in order that methods of cutting and cultural practices can be based on the aspects of root competition as well as crown competition. Likewise the morphology of roots has a direct bearing on physiological studies, particularly in the case of water relationships. In fact any study or plan of work dealing with the establishment and growth of trees is directly concerned with the characteristic root system of the species involved.

### III. Methods

Roots are the most difficult portion of the tree to study and it is conceivable that they are the most variable major structure with which we have to deal. Consequently any work plan prepared prior to actual field work is subject to drastic modification as the study progresses. Without a plan, however, there is a serious possibility that much confusion and lost motion would result.

In view of the magnitude of the study and comparative uncertainty of the duration of funds, a procedure will be followed which will make any portion of the study complete in itself. The initial step will be to locate and permanently mark a series of ponderosa pine

seedlings germinating naturally this spring. Enough of these individuals will be marked so that they can be dug at intervals throughout the season and the development of the seedling root system can be thoroughly understood. Details for this phase of the study are as follows: Locate and permanently stake 100 natural seedlings on both a north and south slope in Pine Creek. On June 1 lift five seedlings on each site and measure the horizontal root spread, the vertical root extension, count the number of primary laterals on main root leader, sketch the root system scale, oven-dry and determine the weight of the roots and photograph the characteristic seedling or group of seedlings. Repeat this procedure on the first of July, August, September, October, and November, determining if possible at each examination whether or not the root is active. This phase of the study requires only 30 seedlings from each site but the reason for staking 100 is to allow for mortality. In fact unless we have a very favorable year it is questionable that 100 seedlings will furnish the requisite 30 samples. If all of the 100 staked seedlings die before the end of the season, it will be necessary to search for additional seedlings which have survived elsewhere. This study will be confined to ponderosa pine for the present season.

In addition to the seedling phase of the study which involves recurrent monthly examination, an attempt will be made to trace the growth and characteristics of ponderosa pine roots by taking representative samples in various age classes. This will be done as follows:



select three 2-year-old seedlings (germinated in 1934) on each of a north and south slope, lift the trees and secure the same information which is to be taken on younger seedlings. Repeat the same procedure for 5-year-old seedlings and if a very striking change in the characteristics of the root system is observed, drop back and sample 3-and 4-year-old trees. It is realized that it will be difficult to find representative trees in the desired age-classes but every reasonable effort should be expended to follow this tentative schedule.

The same procedure for 5-year-old trees should be followed for each 5-year age-class up to 20 years. After that age trees will be selected by 10-year age-classes, allowing a variation of 2 to 3 years on either side of the designated age (28-33) (38-43) etc. A different technique will be necessary in the older and larger trees for two reasons; first, because the root system is larger and more difficult to handle, and second, because active competition between individuals will have begun and we will be interested in trees growing in closed stands as well as free growing trees. The following procedure is suggested for age-classes over 20 years: select three dormant trees in a stand, clear out around them and proceed to excavate the roots. Before beginning to excavate, however, drive a series of 4-foot iron stakes marked in intervals of 1 foot into the stakes. These stakes should be placed so that the investigator will know how much soil he has removed when he reaches certain root-levels.

Excavation will begin at the bole of the tree and as 2 or 3 horizontal roots are uncovered they will be traced out to their tips.

The length of all horizontal roots will be measured and the number of primary laterals counted on each. Special attention will be paid to the tip of the roots to determine whether or not it is still growing and if possible determine its rate of growth. As the horizontal roots are gradually exposed around the tree, divide the root-zone into squares with white twine and sketch the horizontal proportion of the root system on cross-section paper. Leave the tree standing as long as possible so that the root system can be photographed from the crown. Perhaps it will be necessary to whitewash the roots before photographing.

When the root system is finally excavated, sketch an average profile of the system showing horizontal spread and vertical projection. If possible lift the roots from their position and photograph them with the vertical roots projecting upward.

Interrelation of roots between trees should be considered carefully. Sketch the invading roots in a contrasting color to that of the primary roots of the tree being studied.

When any sample tree is taken, describe it fully and also describe its neighbors which might be offering competition. Record DBH, height, length, and spread of crown, growth by decades and apparent vigor.

If root systems for dormant trees up to 40 years of age are determined and thoroughly understood this season and any time remains for further work, it is advisable to trace out the root systems of a few suppressed trees in order to ascertain whether they should be cut in timber stand improvement work.



Considerable care should be exercised in excavating the root systems, particularly near the growing tips. It is assumed that some of the excavating will be done with the regular digging tools, however, if we have a feasible opportunity a hydraulic system may be devised by use of a fire pump.

In addition to merely studying root distributions, detailed observations should be made in respect to root form, growing habits, rate, and the general relationships of site and soil to root characteristics.

When the root system of ponderosa pine is well understood this study will be expanded to include Douglas fir.

It is questionable whether or not the root system of older trees can be studied during the coming season and when time does come for the study of these older trees our experience will make a more effective work plan possible. Hence revision of this plan is called for at the close of the 1935 season.

A series of free-growing trees should be studied as well as trees in the stand and immediately upon completion of the study of trees in stands up to 40 years in age the root systems of free growing trees should be determined by the same general procedure.

#### IV. Assignment

- 1 - Junior Forester
  - 1 - Assistant Technician
  - Laborers as needed
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Director

This general scheme of procedure sounds OK to me, and seems a sufficient base to get the project started on. Undoubtedly many things will be encountered in the field that will modify details and possibly even some of the major points of method, but those can not be foreseen now.

In the study of first-year seedlings, possibly five at each examination is quite sufficient if they are relatively~~ly~~ uniform in size and development, but if they do show quite a range, I think a few more would be desirable, as 10 on each aspect. —This is especially true if we should happen to find any other factors locally that have to be taken into account, other than aspect. Of course we may not be able to find enough, especially after mortality depletes our supply; we shall have to see first what Nature provides. Some scheme should be provided to insure a kind of random selection or representative ~~selection~~ from the various spots where seedlings may have been staked - but this is a minor field detail.

In the study of one-year-olds, it would entail but little additional work and would make the results even more informative in relation to reproduction problems, to take soil moisture samples near the excavated roots, at a range of depths covered by the length of the roots. I suppose that moisture equivalent determinations of the same should also be ~~made~~ to complete the picture, but that gets into an awful job. The subject is one which I had in mind as part of the reproduction study, however, and as far as natural seedlings is concerned, could as well be incorporated here as elsewhere.

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